806 MASONRY UNITS

806.01 CLAY OR SHALE BRICK

Color shall be as specified in the contract documents.

(A) SEWER BRICK. Sewer brick shall meet the physical requirements of AASHTO M 91, Grade MS for manholes and Grade SS for invert surfaces, and shall be 2-1/4 x 3-3/34 x 8 inches in size.

(B) SIDEWALK BRICK. Sidewalk brick shall meet the requirements of ASTM C 902., Class SX, Type I

(C) BUILDING BRICK. Building brick shall meet the requirements of AASHTO M 114, Grade SW.

(D) GUTTER BRICK. Gutter brick shall meet the physical requirements of AASHTO M 91, Grade SS, and shall be of a size as specified. The exposed face of brick shall be smooth.

806.02 PRESSED CONCRETE BLOCK PAVERS

Pressed Concrete Block Pavers shall have a non-slip or stipple finish. Large, rough, exposed aggregate surfaces are not acceptable. All top edges of pavers shall have a 3/16 inch bevel. The color shall be natural limestone gray or as approved by the Engineer. The pavers shall also meet the following requirements.

(A) SIZE. Sidewalk pavers shall be 24 x 36 x 2 inches (nominal) or metric equivalent. Driveway pavers shall be 8 x 4 X 3 inches or metric equivalent. Pavers shall have a tolerance of +/- 1/16 inch in length and width and +/- 1/8 inch in thickness.

(B) COMPRESSIVE STRENGTH. Average compressive strength of four 2 x 2 x 2 inch cubes or 2 inch diameter cylindrical cores obtained from two pavers per lot shall be 5000 psi minimum as tested by AASHTO T 32.

(C) WATER ABSORPTION. Maximum 24 hour cold water absorption shall be less than 5 percent tested in accordance with AASHTO T 32, Section 7, except that 4 specimens will be tested.

(D) FREEZING-THAWING RESISTANCE. After 50 cycles of freezing and thawing, in accordance with AASHTO T 32, or, after a 3 day submersion in 3 percent sodium chloride solution, 1/2 inch deep over the top of the test specimen, weight loss shall be less than 3 percent with no visual signs of deterioration.

806.03 CONCRETE BRICK

Concrete brick shall conform to the composition and physical requirements of ASTM C 55 for the weight, type and grade specified.

806.04 GLAZED CERAMIC TILE

(A) GENERAL. All tile shall be glazed ceramic wall tile of the sizes and shapes specified herein and as shown in the contract documents. The quality of the tile shall be standard and grade as defined in A1371.1 ANSI Standard Specification for Ceramic Tile.

(B) PHYSICAL PROPERTIES. Tiles (other than trimmer tiles, angles, etc.) shall have a nominal size of 4-1/4 inches by 4-1/4 inches. The size of the tile shall not vary from the nominal 4-1/4 inch dimension by more than 3/64 inch. All tile shall be of a uniform thickness of not more than 1/2 inch nor less than 3/8 inch, including the projecting lugs or keys as specified in this section, and not less than 5/16 inch thick exclusive of said lugs or keys. They shall be graded for size into groups by the manufacturer for the Contractor, and each group shall be composed of one size tile varying not more than 1/32 inch. Each group of sizes shall be segregated and shipments shall be made in substantial quantities of one size.

The tiles shall have an approved cushion edge and the backs shall be free from glaze, glaze sheen or film. The edges shall be reasonably free from a glaze coating and shall not have drops or globules exceeding 1/64 inch in thickness. The body shall be free from concave warpage exceeding 0.2 per cent of the diagonal of the square and shall be free from convex warpage exceeding 0.3 percent of the diagonal. They shall be free from wedging or crooked edges exceeding 0.5 percent of the edge length and from other imperfections such as pressing cracks, dents, swelling, and chipping.

The Contractor shall provide approved equipment for checking tile for warpage, wedging and size. The equipment shall mechanically measure compliance or non-compliance of the tile with the specified limits of warpage and wedging and shall classify the tile as to size group.

Tiles shall be manufactured with projecting lugs or keys on the backs and with rough back surfaces so as to furnish a satisfactory mechanical bond with supporting mortar. The width of the back face of the lugs or keys shall be appreciably greater than the width at the base of the said lugs or keys. The lugs or keys shall project not less than 3/32 inch beyond the back face of the body of the tile and shall be of such pattern as to avoid closed pockets by which air might be entrapped within the mortar backing. If the tile is manufactured with projecting edge rims or borders on 2 or more adjacent sides, there shall be provided at least 2 slots on each side of the tile where said rims or borders occur so as to avoid entrapment of air within the mortar backing. These slots shall be not less than 5/16 inch in width and shall extend across the full width of the edge rims or borders and for the full depth of the edge rims or borders to the body of the tile. The pattern of the lugs or keys shall be subject to the approval of the Engineer.

The face of the tile shall be a glazed finish with a semi- matte texture having a specular gloss factor of 21 to 70 units when determined as specified herein. The glazed surface shall be smooth, easily cleaned and free from all imperfections or injurious defects such as waviness, pinholes, specks, spots, blisters, feathering, crawling, crazing, chipping, scumming, discoloration or sanding to an extent which would affect the appearance of the tile. The daylight luminous directional reflectance when measured as specified herein shall be a minimum of 70 percent. The light reflectance requirements do not apply to the darker tile as used for trim.

The color of the tile shall be as specified in the contract documents, and samples of tile having the required finish, texture and color shall be submitted to the Engineer for approval. These samples shall have the following identification: "Samples of Glazed Ceramic Wall Tile Illustrating Finish, Texture and Color Only."

(C) SAMPLING. During progress of the work, the Contractor shall furnish at his own expense as many samples lots of tile as may be required for testing. A sample lot shall consist of 30 tiles. Samples of the tile for test purposes will be selected by the Engineer from tile delivered to the project and shall be identified as a lot. On each project, a sample lot of tile shall be obtained and tested prior to start of tile construction irrespective of the quantity of tile facing involved. On projects involving less than 25,000 square feet of tile, additional samples and testing shall be at the option of the Engineer.

In case the sample from any one lot of tile fails to meet the requirements of these specifications, an additional sample from the same lot will be selected and subjected to the prescribed tests. Should the additional sample also fail to meet specification requirements, the entire lot so represented will be rejected. Rejected tile shall be promptly removed from the job site and disposed of and shall not be used or submitted again for inspection or test.

(D) TESTING. The Contractor shall secure certified results of tests from the manufacturer indicating that the tile being furnished on the project conforms in all respects to the requirements specified. Sampling of tile delivered to the project will be performed as provided herein. Sample lots tested shall meet the requirements of the tests listed below. The tests specified for dimensions, warpage and light reflectance are non-destructive and tiles used for these tests shall also be used for the remainder of the tests.

(1) DIMENSIONS. Five tiles shall be selected at random from the sample lot consisting of 30 tiles and tested for conformance to the requirements specified for dimensions. When so tested, the dimensions for the 5 specimens shall be within the tolerances specified.

(2) WARPAGE. Five tiles shall be selected at random from the sample lot and tested for conformance to the warpage requirements. When so tested, the warpage of the 5 specimens shall be within the tolerances specified.

(3) SPECULAR GLOSS AND LIGHT REFLECTANCE. Five tiles shall also be selected at random for the specular gloss and light reflectance tests. The specular gloss shall be determined in accordance with ASTM D 523, 60 degree Geometry Method. The daylight luminous directional reflectance shall be measured by a Gardner (Hunter design) Color and Color Difference Meter, operated in accordance with manufacturer's instructions. When so tested, the specular gloss and light reflectance of the 5 tiles shall conform to the requirements.

(4) ABSORPTION. A sample consisting of 5 tiles shall be dried in an oven for two hours at 110°C, cooled to room temperature and weighed separately on a scale sensitive to 0.5 gram. The dry tiles shall then be placed in water at a temperature of 15 to 30°C. The water shall be boiled for two hours and permitted to cool gradually to within 15°C to 27°C. The tiles shall be removed from the water 24 hours after the initial immersion, their surfaces wiped dry with a clean damp cloth and quickly weighed separately. The percent absorption of each specimen shall be calculated on the basis of its weight.

The average water absorption of the 5 specimens tested shall not exceed 2 percent. The water absorption of any individual specimen shall not exceed 2-3/4 percent.

(5) CRAZING. An autoclave with sufficient capacity to contain not less than 5 tiles shall be used. The apparatus shall be equipped with a safety valve, blow-off valve, pressure gauge whose accuracy is within 2 percent of the scale range, and a burner of sufficient capacity to insure a constant steam pressure. A sufficient amount of water shall be placed in the autoclave so that after a one hour test at 200 pounds steam pressure, a slight excess of water will remain. The sample consisting of 5 or more tiles shall be loosely placed on edge in a suitable wire container above the water line within the autoclave at room temperature. The autoclave head shall then be securely fastened in place.

The water in the bottom of the autoclave shall be heated from an external source. The blow-off valve shall be kept open until steam begins to escape, thereby expelling most of the air. After closing the blow-off valve, the water shall be kept boiling and the steam pressure increased at a uniform rate until 200 psi is reached within a period not exceeding one hour. Sufficient heat shall be applied to maintain a constant steam pressure of 200 pounds per square inch for an additional hour. The burner shall then be shut off and the steam pressure

immediately released by opening the blow- off valve. The autoclave head shall be loosened but not removed until the specimens have cooled slowly to room temperature and a washable black ink rubbed upon their surfaces to aid in the detection and examination of failure.

After being subjected to 5 consecutive cycles of the foregoing crazing test, the 5 tiles tested shall show no crazing, chipping, spalling or cracking of either the body or glaze. The glazed surface of the tile shall show no permanent clouding, dulling or pitting. Slight dull streaks will be permitted provided they do not comprise more than 20 percent of the glazed surface area.

(6) THERMAL SHOCK. A sample consisting of 3 tiles shall be placed in an oven at room temperature. The temperature within the oven shall then be uniformly raised to 110°C in a period of one hour, and maintained at the temperature for an additional hour after which each specimen shall be removed from the oven and immediately plunged into a mixture of ice and water having a temperature of not more than 2°C. At the end of 10 minutes, each specimen shall be removed from the water mixture and a washable black ink applied upon the glazed surfaces and bodies to aid in the detection and examination of failures.

After being subjected to 5 consecutive cycles of the foregoing thermal shock test, the 5 tiles shall show no crazing, chipping, spalling or cracking of either the body or glaze.

(7) WEATHERING. A sample consisting of 5 tiles shall be placed in water at room temperature. The water shall then be boiled for a period of 2 hours and permitted to cool gradually to room temperature. The specimens shall then be removed from the water and their surfaces wiped dry with a clean damp cloth. Immediately thereafter they shall be placed in a freezing chamber (not immersed in water) for a period of 4 hours. The freezing chamber shall be maintained at a temperature below minus 12°C. The specimens shall then be removed from the freezing chamber and immediately immersed in water at room temperature. After the specimens have completely thawed in the water, they shall be removed, their surfaces wiped dry with a clean damp cloth, and a washable black ink rubbed upon their surfaces to aid in the detection and examination of failures. After being examined, the five tiles shall again be immersed in water until such time as is convenient to again place them in the freezing chamber for the additional cycles of the weather test.

After being subjected to 5 consecutive cycles of the foregoing weather test, the 5 tiles tested shall show no crazing, chipping, spalling, or cracking of either the body or glaze.

(8) GLAZE HARDNESS. A sample consisting of 5 tiles shall be used in the glazed hardness test utilizing the Moh Scale of minerals. A piece of mineral having a hardness of 4 as measured by the Moh Scale shall be slowly drawn across the glazed surface of each specimen with a steady, uniform pressure of approximately 25 pounds. When subjected to the above test, the glazed surface of the 5 tiles shall not show a scratch.

(9) BOND. Before the design of the back of the tiles is approved, the tile shall meet the following requirements: This test will be performed only on the sample of tile obtained prior to start of tile construction.

A layer of mortar shall be placed in the bottom of 5 molds of a thickness of one inch. The mortar shall contain the following, by weight of mix:

Portland Cement-801.01(D) - 1 part
Ottawa Sand-803.06(B) - 2-1/2 parts
Hydrated Lime-(821.03)(E)) - 16-1/2 parts by weight of cement

The inside dimension of the molds shall be 4-3/8 inches square and 1-1/8 inches in depth. The tiles shall be thoroughly wetted following which a skim coat of neat portland cement shall then be spread evenly on the back of each tile, filling all spaces between lugs or keys, to a thickness not exceeding 1/8 inch prior to setting the tile on the mortar. The tile shall be firmly pressed or tapped into place and the bond test specimen consisting of mold, mortar and tile shall be stored in a normal atmosphere at room temperature for 7 days until tested for strength of bond in shear in a suitable compression machine at a rate of load of 2400 pounds per minute. The average strength of bond in shear of the specimen shall not be less than 225 pounds per square inch.

806.05 MORTAR MIXTURES

(A) GENERAL. Materials used in mortar mixtures shall conform to the following:

(1) Masonry Cement - 801.02
(2) Portland Cement - 801.01
(3) Hydrated Lime - 821.03(D)
(4) Fine Aggregates - 803.06
(5) Sand - 803.06(C)
(6) Water - 821.01
(7) Epoxy - 821.10

(B) PORTLAND CEMENT MORTAR MIX.

(1) Mortar for stone masonry (setting) shall be composed of one part portland cement, 3 parts fine aggregate by volume and hydrated lime in an amount equal to 10 per cent of the cement by weight.

(2) Mortar for stone masonry (pointing) shall be composed of one part dark portland cement and 2 parts fine aggregate to which sufficient hydrated lime may be added to make as stiff a mixture as can be properly worked with a caulking tool.

(3) Mortar used for scratch and float coat in ceramic tile construction shall be composed of 1 part portland cement and 2-1/2 parts sand meeting 803.06(C) and 1/5 part hydrated lime (slaked 24 hours minimum before use).

(4) Joint mortar for sewer pipe shall consist of one part Type II portland cement and 2-1/2 parts fine aggregate by volume thoroughly mixed dry, and sufficient water to make a stiff mix.

(5) Joint and parging mortar for manhole brickwork shall consist of one part Type II portland cement and 2-1/4 parts fine aggregate per 803.06(A) by volume and sufficient water to make a stiff mix. Lime in mortar is prohibited.

(C) EPOXY MORTAR. Epoxy mortar shall be composed of sand conforming to 803.06(A) and epoxy conforming to 821.10 and proportioned by volume as follows:

Parts Sand-Dry (by volume)	**Parts Epoxy (by volume)**
1	3 to 4 with Grade 1 Epoxy
1	2 to 3 with Grade 2 Epoxy

1	1 to 1-1/2 with Grade 3 Epoxy

Type and class of epoxy and proportions of sand to epoxy shall be per 821.10(B).

(D) MASONRY CEMENT MORTAR MIX. Masonry mortar shall be composed of one part masonry cement and two parts fine aggregate by weight.

(E) NONSHRINK GROUT. Nonshrink grout shall be premixed, nonmetallic, non corrosive, nonstaining product containing silica sands, portland cement, shrinkage compensating agents, and plasticizing and water-reducing agents. The hardened grout shall obtain 6000 psi minimum compressive strength at 28 days when tested in accordance with AASHTO T 106. The shrinkage shall not exceed 0.00 inches in plastic state when tested in conformance with ASTM C 827 and in hardened state when tested in accordance with Corps of Engineers CRD-C621.

(F) NONSHRINK GROUT FOR SEWER-WATER WORK. Nonshrink grout for sewer-water work shall be premixed, non-metallic, non-corrosive, non-staining product containing silica sands, portland cement, shrinkage compensating agents, and plasticizing and water-reducing agents.

The Contractor shall furnish recent independent laboratory tests showing compliance with requirements specified. Certification or affidavits will not be acceptable.

The Contractor shall furnish manufacturer's literature describing product and instructions for use.

Grout shall be delivered in moisture proof bags with the manufacturer's name, product name and general instructions for placement printed on the bag.

The product shall be stored on pallets and protected from damage.

All grout shall be non-metallic, non-shrink, non-gas forming, preblended and ready-for-use requiring only the addition of water.

(1) Grout shall contain no metals nor rust or corrosion promoting agents, or gypsums.

(2) The addition of set control agents or water reducers shall not be allowed.

(3) Grout shall conform to the following properties:

Property	**Test Methods**	**Requirements**
Shrinkage below Placement Volume	ASTM C 827	0
Drying Shrinkage	CRD 588-76	0
Expansion	CRD 588-76	0.10 max.
Compressive Strength*		
24 hours	3,000 psi min.	AASHTO T 106
7 day	6,000 psi min.	AASHTO T 106
Initial Set Time	ASTM C 191	Min. 45 minutes
Pull-Out Strength	#5 bar grouted 6" deep in a 7/8" dia. hole	10,000 lbs.

	in saturated surface dried concrete

*Flowable mix

Water shall be clean and free from injurious chemicals and deleterious materials.